NON-INDEPENDENT HYDRAULIC HEADER LIFT AND FLOTATION SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application relates to utility patent application serial number __ filed on the same date as the instant application and entitled "Independent Hydraulic Header Lift and Flotation System", attorney docket number 15164.

BACKGROUND OF THE INVENTION

[0002] The present invention relates generally to harvesting machines of the type that require flotation systems for permitting their headers to ride lightly up and over rises in the terrain during field operation, and particularly to a hydraulic header lift and flotation system for such a machine that will provide the dual functions of header lift and flotation.

[0003] Header flotation systems typically use extension springs, either hydraulically or manually adjusted, bell cranks and other linkages to provide the desired function. The structure generally requires numerous components and large extension springs, and it is quite difficult to develop the mechanical components required to float the broad range of header sizes available—even requiring different tractors or frames having their own flotation systems designed to meet their own particular header weight requirements.

[0004] Some manufacturers are using an accumulator and hydraulic cylinders to perform the flotation function. These machines typically use separate hydraulic cylinders for the lift and flotation functions, and they lack the

capability of independently adjusting the flotation force for each side of the header. Additionally, some headers are not inherently balanced side to side. Special considerations must be made to float and lift these headers evenly by adding ballast, which can become unreasonably heavy or awkward, or modifying the lift geometry of one side.

[0005] It would be quite beneficial to have a header lift and flotation system that employs a single hydraulic cylinder for each side of the header, simplifying the controls and mechanical components necessary to perform these functions.

SUMMARY OF THE INVENTION

[0006] Accordingly, it is an object of the present invention is to provide a hydraulic lift and flotation system for the header of a crop harvesting machine that employs a single hydraulic cylinder for each side of the header.

[0007] Another object of the present invention is to provide a hydraulic lift and flotation system to be used with both heavy and light headers/conditioners, i.e., a broad range of header sizes and weights.

[0008] It is another object of the instant invention to provide a more simplified structure that presents greater flexibility in locating the accumulator as opposed to extension springs and necessary linkages, with fewer pivot points to wear and fewer parts to manufacture and assemble.

[0009] It is still another object of the instant invention to provide a flotation and lift system that requires no dealer or customer assembly.

[0010] It is an even still further object of the instant invention to provide a hydraulic header flotation and lift system that reduces hydraulic and mechanical shock loading when raising the header in a less than fully raised position, improving the ride comfort for the operator and improving hydraulic and structural durability of the harvester.

[0011] It is yet another object of this invention to provide an improved hydraulic header lift and flotation system that is durable in construction, inexpensive of manufacture, carefree of maintenance, facile in assemblage, and simple and effective in use.

[0012] These and other objects are attained by providing a hydraulic lift/flotation system for the header of a crop harvesting machine. Each side of the header is supported by a single cylinder that performs both the flotation and lift functions. To accommodate unbalanced headers (center of gravity not centered between the lift arms), hydraulic oil is sent to the return side of the lift cylinder on the lighter side of the header, thus resulting in even raising, lowering and float.

DESCRIPTION OF THE DRAWINGS

[0013] The advantages of this invention will be apparent upon consideration of the following detailed disclosure of the invention, especially when taken in conjunction with the accompanying drawings wherein:

[0014] Fig. 1 is a partial side elevational view of a crop harvesting machine of the type with which the invention may be used, also showing a simplified side view of the lift and flotation system of the instant invention; and

[0015] Fig. 2 is a hydraulic schematic view of one embodiment of the hydraulic system of the instant invention; and

[0016] Fig. 3 is a schematic of the hydraulic, mechanical and electrical sub-systems that cooperate to produce the system of Figs. 1 and 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0017] Many of the fastening, connection, processes and other means and components utilized in this invention are widely known and used in the field of the invention described, and their exact nature or type is not necessary for an understanding and use of the invention by a person skilled in the art, and they will not therefore be discussed in significant detail. Also, any reference herein to the terms "left" or "right" are used as a matter of mere convenience, and are determined by standing at the rear of the machine facing in its normal direction of travel. Furthermore, the various components shown or described herein for any specific application of this invention can be varied or altered as anticipated by this invention and the practice of a specific application of any element may already by widely known or used in the art by persons skilled in the art and each will likewise not therefore be discussed in significant detail.

[0018] Fig. 1 shows the present invention utilized in connection with a self-propelled windrower 10; however, it will be appreciated that the principles of the present invention are not limited to a self-propelled windrower, or to any specific type of harvesting machine.

[0019] In the illustrated embodiment, the self-propelled windrower 10 comprises a tractor 12 and a header 14, the header 14 being attached to the front end of the frame 16 or chassis of the tractor 12. The header may be of generally any suitable construction and design, and may include not only crop-harvesting mechanisms, but also crop conditioners such as elongate rolls 15. Such attachment of the header 14 to the frame 16 is achieved through a pair of

lower arms 18 (only the left one being shown, the right being generally the same) pivoted at one end to the frame 16 and at the other end to the header 14, as well as through a central upper link 20. The link 20 may take the form of a single double-acting hydraulic cylinder 21 whose extension and retraction is controlled by the operator to remotely control the angle of sickle bar 22 on the lower front of the header 14.

[0020] A single lift/flotation cylinder 24, interconnecting the lower arm 18 and the frame 16 supports each side of the header, i.e., each side of the header is supported by its own lift/flotation cylinder (again, only the left one being shown in this Fig. 1).

[0021] More specifically, the control system accomplishes two generally separate control functions, one for the right side lift/flotation cylinder and one for the left.

[0022] Directing attention now to Fig. 2, the hydraulic control system for left cylinder 24 and right cylinder 26 can be seen to include an electro-hydraulic subsystem generally depicted as 30. For convenience of assembly and operation, the majority of the components are housed in a single valve body 34 with appropriately located ports and other necessary connection devices and fixtures. A fixed displacement pump 36 moves the hydraulic fluid into subsystem 30 from reservoir 40, through the various circuits as directed by control valves, to a single accumulator 42, to hydraulic cylinders 24, 26 and back to reservoir 40 as appropriate.

[0023] Fig. 3 provides a more detailed depiction of the complete control system and subsystems. The hydraulic system, as shown also in Fig. 2, additionally depicts the electrical control and mechanical subsystems. Importantly, this figure depicts the multi-channel programmable controller 50

which exchanges electrical signals from the float switch 52, the PWM (pulse width modulated) solenoid 56, the unload/relief valve 60, and other valves to manage the lift and flotation functions as established by the operator through the appropriate switch and shown on display 64.

[0024] The hydraulic cylinders, attached to respective ends of the header, perform both the lift and flotation functions. The lifting and floating function is achieved by coupling the lifting end of the hydraulic cylinders to each other and then to a hydraulic pump, control manifold, and accumulator. The operator sets the desired flotation force by actuating a rocker switch located on the operator's console. One switch position allows hydraulic oil to enter the accumulator (increasing the hydraulic pressure), which reduces the header contact force, or flotation force, with the ground. The other switch position allows oil to exit the accumulator (reducing the hydraulic pressure), which increases the header contact force with the ground. Once the flotation force is set, the control valves will return to this preset flotation condition whenever the float mode is selected, irrespective of subsequent header lift and lower operations.

[0025] To accommodate unbalanced headers (the header center of gravity is not centered between the lift arms), hydraulic oil is applied to the return side of the lift cylinder on the lighter side of the header. The addition of a defined hydraulic pressure on the back side of the cylinder results in the same lifting pressure to be required for each side. The header will then raise, lower, and float evenly. The result is the same as changing the lift geometry or adding ballast to the header. This function is referred to as the "hydraulic counterweight".

[0026] The hydraulic oil is supplied from the hydraulic ground drive charge pump, which provides constant pressure any time the engine is running. To prevent cavitation of the charge pump during rapid changes in system volume, such as during the header lower cycle, makeup oil is supplied from the header lift

pump. The operator sets the hydraulic counterweight by turning a manual control valve 66 to apply more weight (hydraulic pressure) to the light side of the header until the header raises and lowers to a level condition. If too much weight is applied, the operator simply turns the valve in the opposite direction. Once the correct setting is established, the hydraulic counterweight will not need to be readjusted during machine operation. Re-adjustment will only become necessary if the header builds up with debris or upon exchange with another header.

[0027] For headers that experience severe changes in balance during normal operation, i.e., draper headers with deck-shift, an electro-hydraulic valve can be installed in place of the manual control valve. This electro-hydraulic valve is adjusted from a rocker switch on the operator's console. The operator then sets the hydraulic counterweight for each deck position. Once these values are established, the control valve will adjust automatically and the deck positions are selected.

[0028] It will be understood that changes in the details, materials, steps and arrangements of parts which have been described and illustrated to explain the nature of the invention will occur to and may be made by those skilled in the art upon a reading of this disclosure within the principles and scope of the invention. The foregoing description illustrates the preferred embodiment of the invention; however, concepts, as based upon the description, may be employed in other embodiments without departing from the scope of the inventions. Accordingly, the following claims are intended to protect the invention broadly as well as in the specific form shown.